

active substance comprising lithium manganese oxide, and the negative electrode comprises active substance comprising amorphous carbonaceous material and/or graphitized carbonaceous material. A cumulative concentration of water ( $H_2O$ ) released from both of the positive electrode and the negative electrode in relation to the weight of said electrode unit, exclusive of weight of current collectors, is suppressed to 5,000 ppm or lower upon heating both electrodes at 25 to 200°C and to 1,500 ppm or lower upon heating the electrodes at 200 to 300°C.

In a second aspect of the present invention (claim 17), there is provided a lithium secondary battery comprising an electrode unit in which the positive electrode comprises active substance comprising lithium manganese oxide, and the negative electrode comprises active substance comprising amorphous carbonaceous material and/or graphitized carbonaceous material. A cumulative concentration of water ( $H_2O$ ), determined using Karl Fischer's method, released from both of the positive electrode and the negative electrode in relation to the weight of the electrode unit, exclusive of weight of current collectors, is suppressed to 5,000 ppm or lower upon heating both electrodes at 25 to 200°C and to 1,500 ppm or lower upon heating the electrodes at 200 to 300°C.

Takami '544 is directed to a lithium secondary battery having, according to the patent, an improved negative electrode containing a carbonaceous material (Takami '544, col. 1, lines 9-12).

According to Takami '544, lithium secondary batteries have not been put into practical use, mainly because the charge/discharge efficiency of the battery is low and the number of charge/discharge times (or cycle life) thereof is still insufficient (Takami '544, col. 1, lines 44-48). The cause for this poor performance, Takami '544 discloses, is assumed to be ascribed to the fact that lithium constituting the negative electrode is degraded due to a reaction with a nonaqueous electrolyte (Takami '544, col. 1, lines 48-51).

Takami '544 discloses a lithium secondary battery comprising a positive electrode, a negative electrode comprising a carbonaceous material which is capable of absorbing and desorbing lithium ions, and a nonaqueous electrolyte (Takami '544, col. 2, lines 55-59). The carbonaceous material has a region of amorphous carbon structure and a region of graphite structure, and the carbonaceous material has a true density of 1.8 g/cm<sup>3</sup> or more and a peak in

powder X-ray diffraction which corresponds to not more than 0.340 nm in an interplanar spacing  $d_{002}$  derived from (002) reflection (Takami '544, col. 2, lines 60-65).

According to Takami '544, as for the positive electrode active material, various kinds of oxides, such as manganese dioxide, lithium/manganese composite oxide, lithium-containing nickel oxide, lithium-containing cobalt oxide, lithium-containing nickel cobalt oxide, lithium-containing iron oxide and lithium-containing vanadium oxide; or chalcogen compounds such as titanium disulfate or molybdenum disulfate may be employed. Among them, lithium cobalt oxide {for example,  $\text{Li}_x\text{CoO}_2$  ( $0.8 \leq x \leq 1$ )}, lithium nickel oxide (for example,  $\text{LiNiO}_2$ ) and lithium manganese oxide (for example,  $\text{LiMn}_2\text{O}_4$ ,  $\text{LiMnO}_2$ ) are preferable in view of obtaining a high voltage (Takami '544, col. 4, lines 39-49).

Watanabe '644 discloses a non-aqueous electrolyte secondary battery which uses  $\text{Li}_x\text{SiO}_y$  as the negative electrode active material and  $\text{Li}_x\text{Ti}_y\text{O}_4$  or  $\text{Li}_x\text{FeS}_y$  as the positive electrode active material (Watanabe '644, Abstract).

According to Watanabe '644, "[i]t is desirable that *the battery of the present invention* is assembled in a moisture-free atmosphere or an inert gas atmosphere. Further, it is preferable that parts before assembling are previously dried. As drying or moisture-eliminating method of pellet, sheet and other parts, the methods generally used can be employed. In particular, it is preferred to use hot air, vacuum, infrared ray, far infrared ray, electrom beam, and low moisture air. Those are used alone or in combination of two or more thereof. The temperature is preferably in the range of 80 to 350.degree. C., and more preferably 100 to 250.degree. C. The moisture content is preferably 2,000 ppm or less as the entire battery, and it is preferred for the positive electrode mixture, the negative electrode mixture or the electrolyte to be 50 ppm or less from the point of cycle property." (Watanabe '644, col. 14, lines 37-52).

Watanabe '644 fails to suggest that any of the features disclosed therein, e.g., moisture content of 2,000 ppm or less as the entire battery, would provide any benefit in batteries which do not employ positive and negative active materials as disclosed in Watanabe '644. As noted above, Watanabe '644 discloses that it is desirable that "*the battery of the present invention*" be assembled in a moisture-free atmosphere or an inert gas atmosphere. Watanabe '644 contains no suggestion that any benefit would be produced by following the disclosure in Watanabe '644 unless the electrodes of the battery correspond to those described in

Watanabe '644, namely,  $\text{Li}_x\text{SiO}_y$ , as the negative electrode active material and  $\text{Li}_x\text{Ti}_y\text{O}_4$  or  $\text{Li}_x\text{FeS}_y$ , as the positive electrode active material.

Takami '544 discloses a lithium secondary battery having, according to the patent, "an improved negative electrode containing a carbonaceous material", and in which various kinds of oxides, such as manganese dioxide, lithium/manganese composite oxide, lithium-containing nickel oxide, lithium-containing cobalt oxide, lithium-containing nickel cobalt oxide, lithium-containing iron oxide and lithium-containing vanadium oxide; or chalcogen compounds such as titanium disulfate or molybdenum disulfate may be employed for the positive electrode active material.

Any assertion that Watanabe '644 suggests reducing moisture content in *all* lithium secondary batteries, regardless of the electrode active materials, clearly goes beyond what is disclosed in Watanabe '644.

In addition, neither of the applied references contains any indication that the battery of Takami '544 could be made to have the water content properties disclosed in Watanabe '644, unless the battery includes a negative electrode active material of lithium-containing silicon oxide represented by the compositional formula  $\text{Li}_x\text{SiO}_y$ , and a positive electrode active material of lithium-containing titanium oxide represented by the general formula  $\text{Li}_x\text{Ti}_y\text{O}_4$  or lithium-containing iron sulfide represented by the general formula  $\text{Li}_x\text{FeS}_y$ .

U.S. Patent No. 6,361,822 (Kurose '822) is referred to in the Office Action. Kurose '822 is directed to a method for producing an electrode for a non-aqueous electrolyte battery, and more particularly, to a method for producing a non-aqueous electrolyte battery electrode which includes an electrode active material layer containing at least an active material having a composition of  $\text{Li}_x\text{Ni}_y\text{M}_z\text{O}_2$  (where  $x$  satisfies  $0.8 < x < 1.5$ ,  $y+z$  satisfies  $0.8 < y+z < 1.2$ ,  $z$  satisfies  $0 \leq z < 0.35$ , and  $M$  is at least one element selected from Co, Mg, Ca, Sr, Al, Mn and Fe).

Kurose '822 contains no suggestion to one of skill in the art that disclosure in Watanabe '644 about the electrodes therein is broadly applicable to *all* electrodes. As noted above, Watanabe '644 discloses a battery in which a negative electrode active has the compositional formula  $\text{Li}_x\text{SiO}_y$ , and a positive electrode active material is represented by the general formula  $\text{Li}_x\text{Ti}_y\text{O}_4$  or  $\text{Li}_x\text{FeS}_y$ .

Accordingly, it is respectfully requested that the U.S. Patent and Trademark Office reconsider and withdraw this rejection.

In view of the above, claims 1-17 are in condition for allowance.

If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

November 15, 2004

Date



Kevin C. Brown  
Reg. No. 32,402

KCB:jms

BURR & BROWN  
P.O. Box 7068  
Syracuse, NY 13261-7068

Customer No.: 025191  
Telephone: (315) 233-8300  
Facsimile: (315) 233-8320